



## **Short-term prediction of the landslides initiated activity in studies of the steep slopes**

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Problems of geo-dynamic safety of the city at the areas of steep slopes at present time are being solved basing on evaluation of the tensed conditions of landslide massifs. Geodynamic processes on the landslide that were activated by natural and/or artificial processes entail formation of micro- cracks that release energy of the elastic recoil and form sources of electromagnetic radiation. That happens due to rise of dislocation currents, induction effects of unstable flow of liquid, formation of dipoles charges on opposite edges of cracks, relaxation of these charges, influence of the acoustic radiation upon conducting rocks in the magnetic field of the Earth, plasma effects inside the crack, etc. Formation of micro- crack is accompanied with acoustic and electromagnetic emission of quazi-garmonic and pulse character.

By increase of influence of technogenic and/or natural origin micro-cracks unite into coarse line ruptures with emission of much greater energy of the elastic recoil and acoustic emission of lower frequencies. High frequencies of both acoustic and electromagnetic emission remain in the radiation.

Energy of emission depends upon energy of elastic recoil in the zones of tensed condition of the landslide's body and its bed. It usually emit gradually. Energy of the elastic recoil is determined by general energy accumulated in the landslide massif and forms only its little portion. Apparently, the more energy accumulated the more energy of the elastic recoil. That is why capacity of the emission determines tensed condition of the landslide's body in quality, and number of pulses determines capacity of the cracks formation. Basing on character of the acoustic and electromagnetic emission is possible to carry out geo-dynamic zoning of the landslide massifs, and on their change in time to fulfill monitoring of the landslides.

Monitoring of electromagnetic emission executed on frequencies of VLF-radio-

stations and in the intervals between them. Measures are fulfilled in narrow and wide intervals. Capacity of emission and number of pulses during certain interval are also measured. Monitoring of electromagnetic emission is made basing on amplitude, capacity, impulse radiation, and by scanning of these parameters on frequencies. Monitoring of the acoustic emission is carried out basing on frequency content, capacity and pulse radiation. Space study of the acoustic and electromagnetic emission was carried out by square surveys during short time interval, and monitoring was fulfilled being repeated during day, month and year.

Studies of anomalies of VLF-signals from radio-stations are carried out for detection in the mountain rocks of the anomalous conductivity which usually controls tectonic displacements. It is expected that natural electromagnetic radiation (NEMR) continually carried out on the landslide, can be created by induction sources generated in the zones of conductivity. These anomalies are not much interesting for us because their characterizing of the tensed condition of the landslide is not reliable. Accidental NEMR usually arises during deformations, crushing and abrasion of the rocks; it rises and disappears accidentally and serves a characteristic of the tensed condition of the rocks.

Process of the slope stability breach depends upon a range of geological and structural-tectonic factors, which are under influence of another forces, for example, earthquakes, explosions and/or events of inundation during the rain, destruction of the slopes by roads, and other technogenic influences.

Range of factors influence upon the steep slope constantly, and it is possible to predict its reaction from year to year, from month to month and even in certain days. Other factors, for example the earthquake appear unexpected and it is difficult to foresee their influence. It is necessary to investigate the landslides after such influences. The operative investigation of the landslides is possible to carry out in acoustic and electromagnetic fields. However, these studies can be late. That is why we suggest carrying out investigation of the landslides basing on influence of the earthquakes' forerunners upon them, usually forestalling the earthquake in few days. That is possible because: - First, the landslide reacts on the earthquakes forerunners by re-radiation of the acoustic emission and its intensification in certain ('focal') places. This acoustic emission usually not accompanied by electromagnetic emission that allows distinguishing it from the landslide emission itself. - Second, loss of the slope steadiness is accompanied by acoustic and electromagnetic (usually impulse) emissions. If they are not short-term forerunners of strong earthquake that reached the observer on the landslide by long transfers via atmosphere and ionosphere, it must be activation of the landslide. Solution of these problems based on analyses of frequency content of the acoustic and electromagnetic emissions, their correlation, intensity, and direction.

In Crimea on 7 August 2003 had taken place the prediction of landslide activation on electromagnetic and acoustic emissions studying results. This activation of the landslide have started in 10-11 hours and finished in 3-4 hours before the earthquake, resulting influence of the forerunners of the earthquake. Approximately in 3 hours before the earthquake activation of the landslide stopped resulting the tension' taking down due to formation of cracks. Further, after the earthquake activation of the landslide repeated few times more with gradual damping out of the activation energy. Next, after approximately 14 hours the acoustic emission started to emit, that significantly increased after approximately 15 hours and continued during 10 hours after the earthquake. Graphics of the acoustic emission evidence presence of large number of "flicks". That can say about mass formation of cracks that resulted in arising of the line cracks and, finally, ruptures on the landslide's surface.